

ENVIRONMENTAL PROTECTION IN ENERGY SECTOR **(5 ECTS credits) *Compulsory***

Responsible person:

Prof. dr. Janusz Gołaś, prof. dr. Teresa Grzybek

Learning outcomes:

The main objective of the course is to acquaint the students with the knowledge of the main components of the environment, main sources of contaminations in the environment, methods of reduction the pollution which apply to power and energy sector and their use in technologies and systems which limit the emission of pollutants, selection and creation of environmental friendly technologies with a special attention given to clean and renewable sources of energy.

After completion of the course students should be able to:

- Describe the main dangers to environment resulting from energy industry and the current state of technologies of environmental protection in energy sector.
- Discuss and present to the public the current technological state of the above.
- Be familiar with legal standards for main emissions in energy sector. Propose preventive measures, as well as technologies of emission reduction.
- Basing on experimental/technological data, indicate typical methods to protect environment
- Choose an appropriate analytical method to determine most important pollutants
- choose basic analytical methods to determine the influence of pollutants on environment

Course main content:

The course is built of three parts: lectures (30 h), laboratory (15 h) and seminars (15 h)

Lectures:

Lectures will concern the following subjects:

During the course the students should get fundamental knowledge on main components of the environment and their chemical composition. Biosphere, its role and range. A course gives the foundation to understanding of the behaviour and the migration of chemical substances in the environment, chemical correlations between main components of the environment and chemical cycles of elements. Groups of contaminants both organic (CFCs, PCBs, PAHs, dioxins, BTX, POCs) and inorganic (heavy metals like mercury, lead, cadmium and arsenium as examples and their compounds), main sources of their emission and chemical effects of their presence in the environment are discussed. Phenomena of acid rain, greenhouse effect, smog and ozone layer are presented. Hydrosphere. Water and aqueous solutions . Composition of soil, sediments and atmosphere. Chemistry of bioprocesses like respiration and photosynthesis. Fuels and their sources. Environmental consequences of energy production and consumption.

Noise and its limitations. Municipal and industrial sewage. Classification of fuels and energy resources. Biomass and its role in energy production. Nuclear power sources and their impact on environment

The methods of reduction of pollutants in energy sector. Particulate removal devices; primary and secondary methods of SO₂ control; primary and secondary methods of NO_x control (burner optimization, air staging, flue gas recirculation, fuel staging, low Nox burners; selective catalytic reduction SCR, selective non-catalytic reduction SNCR); Water requirements for power stations (pH, hardness, suspended solids, SDI, specific conductance etc). Water treatment for fossil fuel power generation (water softening -chemical methods, reverse osmosis, ion exchangers etc.). Waste water treatment. Solid waste created by power plants. Fly ash and its utilization..

Laboratory:

1. Basic parameters of water analyses and standards for waters and sewage: determination of NO₃⁻, NO₂⁻, PO₄³⁻, NH₄⁺, Fe, CO₂, NH₃. Total and carbonate hardness of water, pH. Comparison to environmental standards. Odor, Eh, electrical conductivity, oxygenation
2. Determination of ash content in selected grain classes of coal.
3. Heavy metals in environment: analysis of total mercury in wastes, dusts and fly ashes
4. Field trip to Electrical Power Plant Jaworzno III
5. Field trip to Sewage Treatment Plant of Municipal Sewage and Water Company

Seminars:

Seminars are connected to subjects presented during the lectures.

Admission requirements:

Basics in chemistry and/or physical chemistry

Literature:

Environmental Chemistry, Peter O'Neill, Chapman & Hall, UK, 1993 (second edition)

Environmental Chemistry, A Modular Approach, Ian Williams, John Wiley & Sons,Ltd, 2005

Assessment:

- evaluation of laboratory reports
- evaluation of presentation prepared for a seminar and discussion following the presentation
- examination: written examination – solving problems defined by the ILOs.

Rules of final credit: The average of the grades: laboratory (30 %), seminar (30 %) and examination (40 %).